Health Nudges: How Behavioral Engineering Can Reduce Chocolate Consumption

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Abstract

The present chapter explores behavioral techniques to support consumers in moderating their chocolate consumption. Supporting consumers to resist the lure of chocolate is important because obesity is on the rise, and systematic overconsumption of chocolate may bring about severe health consequences. The chapter starts from the observation that various cues in the decision environment can threaten consumer self-control by shifting the balance between short-term and long-term considerations about consumption in favor of the former. A behavioral engineering approach is presented to help consumers deal with situational influences, and change behavior in a sustainable way. In a first part, nudging is introduced as a behavioral technique that can be applied in support of food choice-making. As the effect of nudges typically fades once they disappear from the decision environment, the second part of the chapter explores mechanisms that can extend behavioral effects of nudges and eventually yield stable changes in behavior.

Keywords: self-control; overconsumption; nudge; behavioral engineering; behavioral change

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Chocolate typically is regarded as an enticing food by a vast proportion of consumers. This is not without costs, as chocolate also is known to be relatively unhealthy (i.e., it contains high amounts of fat and sugar). In fact, literature on consumer self-control often uses chocolate as the prototypical example of a so-called 'vice', a good that is likely to be consumed on impulse and therefore may impose a self-control problem (Wansink and Chandon 2014; Wertenbroch 1998). For example, ignoring long-term health consequences, consumers may prefer a piece of chocolate cake (a relative vice) over a fruit salad (a relative virtue), because they prefer the taste of chocolate. Ignoring short-term taste differences however, the same consumers may prefer the fruit salad over the chocolate pie when they consider the long-term health consequences of a fatty diet. Such preference orders can give rise to dynamically inconsistent choices by consumers whose tradeoffs between short-term and long-term consequences of consumption depend on a variety of factors, some of which we will discuss in more detail in the present chapter.

The fact that consumers may be tempted to over-consume vices like chocolate without doubt contributes to the obesity epidemic the Western world struggles with these days. According to the World Health Organization (WHO), worldwide obesity has nearly doubled since 1980. In 2008, over 1.4 billion adult consumers were overweight, of which over 500 million were obese. In 2012, over 40 million children under the age of five were overweight or obese. This upsurge in obesity puts a lot of pressure on health care systems worldwide, given that common health consequences of obesity are diseases that are expensive to treat, like cardiovascular diseases, diabetes, or some cancers. As this example clearly shows, welfare of consumers and societies worldwide could be heavily improved if consumers succeeded in making more competent decisions, or decisions in which there is a healthy balance between short-term and long-term

considerations. Consumers should be able to enjoy a good piece of chocolate cake once in a while, yet they should not systematically over-consume and put their health at risk.

The aim of the present chapter is to propose a set of strategies designed to change human behavior in a sustainable way, and to apply them to food decision making. Specifically, we want to explore strategies aimed at stimulating enduring healthy food choices in consumers. Food decision making is rather complex, and has proven relatively resistant to change. Policy makers typically pursue two major avenues for changing behavior and increasing consumer welfare: (1) they want to provide more and more objective information such that consumers can make better informed and hence better decisions (e.g., clearly indicate the number of calories on food packaging), and (2) they want to provide more options such that the likelihood increases that consumers can select the option that supports their welfare best (e.g., also provide low-fat alternatives). Although policy campaigns based on these premises are often successful in increasing awareness (e.g., consumers know that eating fatty food is bad for them), they are often less successful in changing behavior (e.g., obesity is on the rise), let alone in triggering enduring behavioral change.

In a first part of this chapter, we will present nudging as a novel and cost-effective behavioral technique that can be applied in support of healthy food choice-making. Nudges are defined as subtle rearrangements in the decision environment that support consumers in adopting welfare enhancing behaviors, like choosing healthy food options (Thaler and Sunstein 2008). Nudges support autonomous decision-making and require little effort from consumers. However, nudges typically also have the disadvantage that their effect fades once they disappear from the decision environment (i.e., their influence is short-lived). Therefore, in a second part of this chapter, we elaborate on the potential of nudges to influence autonomous motivation to pick healthy food

options also in the long-run (after the nudge has been removed), and eventually lead to stable changes in behavior (i.e., we put forward the idea that the influence of nudges could be longer-lived than what is typically assumed). Before going into these issues however, we will present some empirical evidence for consumers' vulnerability to the lure of chocolate, which stresses the need for behavioral techniques to overcome this temptation.

Consumer vulnerability

Dual-process theories put forward that behavior results from two distinct but interacting systems: A slow, deliberate, and rational system on the one hand, and a fast, impulsive, and affective system on the other hand (e.g., Thaler and Shefrin 1981). Whereas the former system has received most attention traditionally, research has increasingly focused on the latter, and evidence for it has accumulated. Various choices including food choices are quick, intuitive, automatic, and/or cued by environmental stimuli (based on habit, affect, or impulse). Deliberation about long-term consequences of choices or actions is often lacking (Kahneman 2011). An imbalance between both systems puts consumers at risk of making suboptimal decisions.

Situations in which consumers tend to give in to the lure of chocolate arise rather easily. For instance, research has shown that mundane events like brief shopping trips to the supermarket can drain consumers' cognitive resources to the extent that they become rather impulsive towards the end of their shopping trip, and susceptible to salient affective product features. Specifically, in one lab study (Bruyneel et al. 2006), participants were asked to visit a simulated store and select products, relying on an incentive-compatible procedure. Participants were

randomly assigned to one of two conditions: a choice or a no-choice condition. Participants in both conditions received a shopping list. In the choice condition, the shopping list consisted of product category names. For each of these product categories, participants had to decide which out of two options to select. In the no-choice condition, the shopping list contained the names of products instead of product categories, hence participants did not make active product decisions. To increase comparability between the two conditions, no-choice participants were yoked to the choice participants with respect to the product choices, meaning that product choices were identical across conditions. The major difference was that the no-choice condition involved no active choice-making regarding the products on their shopping list. Only for the last product category, which represented the dependent measure, did participants in the no-choice condition (like participants in the choice condition) make a decision between two product options. This product category was chocolates, and one type of chocolate (Santa Claus-shaped chocolates) was more attractive (following the results of a pretest) but more expensive than the other type of chocolate (elf-shaped chocolates). Functionality of both types of chocolates (e.g., size, weight, taste) was identical. Prices for both chocolates were selected such that the price difference between the options was larger than the price difference participants would probably expect (i.e., a price difference based on the results of a pretest). Participants in the choice condition were relatively more influenced by attractiveness than price than participants in the no-choice condition (i.e., the former selected the more attractive but expensive chocolate type more often). This study shows that consumers become relatively impulsive after a series of active product choices (compared with after a series of compliances with purchase instructions), suggesting that active-choice making is the process through which cognitive resources get drained and impulsivity is increased during shopping.

Another example of a factor frequently encountered in advertising and retail contexts that has been shown to stimulate impulsive purchase behavior, is exposure to sexually-laden cues. In one lab study (Festjens et al. 2014), participants were asked to rate a piece of clothing that typically has a sexual connotation (i.e., a pair of boxer shorts for female participants, and a bra for male participants), and that was either placed in front of them ready to be touched (i.e., tactile sex cue condition) or placed behind a barrier of Plexiglas (i.e., visual sex cue condition). Participants in the control condition were asked to rate a (gender neutral) t-shirt that was put in from of them ready to be touched. Next, all participants were asked to indicate the amount of money they would be willing to pay for rewarding products like a box of chocolates and a bottle of wine. Both men and women's willingness to pay for chocolates and wine was increased after they had touched sexually-laden pieces of clothing compared with after they had touched a neutral t-shirt. In addition, men's willingness to pay was also increased after they had merely seen (and not touched) a bra. This was not the case for women, who needed to touch the sexually-laden piece of clothing (and not merely see it) before their economic decisions were altered. These findings clearly show that both genders are vulnerable to the influence of sexually-laden cues, and become more impulsive if they encounter such cues in their decision environment. Hence, exposure to sexually-laden cues is another factor influencing the equilibrium between short-term and long-term considerations.

In a study that was recently conducted in our lab (Stamos et al. in preparation), we attempted to obtain more insight in the influence of a dual-processing system on the economic rationality of consumers, using a direct measure of economic rationality. Relying on the theory of revealed

preferences, a task was developed to investigate rationality of choices based on the deliberative system on the one hand and the affective system on the other hand (cf. Thaler and Shefrin 1981), and also overall rationality level across both systems. This was done by capturing budget loss resulting from choice behaviors relying on either one of the systems. Specifically, we created a choice task to assess consumers' revealed preferences. The task included several sequential choice problems, with each choice problem consisting of four products: two vice, relatively tasty but not so healthy (chocolate bar and Dorito chips) products and two virtue, relatively healthy but not so tasty (baby carrots and raisins) products. The prices of the products differed for every choice problem. Participants were asked to indicate the quantities they wanted from each product given the different price regimes and their budget (10 tokens, which they were asked to spend entirely). Participants completed this task twice, once in a hungry (affective) state, and once in a satiated (deliberative) state. In the hungry state, participants were instructed to not eat for at least four hours prior to the study. In the satiated state, participants were instructed to eat a full meal within an hour prior to the study. A visceral state like hunger is known to have a direct hedonic impact and influence the relative desirability of different goods and actions (Loewenstein 1996). Specifically, visceral influences have been associated with more affective and less deliberate behaviors. Hence, we expected the visceral state hunger to trigger more affective system behaviors and less deliberate system behaviors relative to the satiated state. The fact that participants engaged in the choice task twice allowed to not only assess rationality within one state, but also to assess rationality across states. The order of the tasks was counterbalanced and separated by one week. As expected, participants selected more vice products when in a hungry state than when in a satiated state, which again shows that decisions makers are easily influenced by a variety of factors (in this case hunger) when making tradeoffs between short-term and long-

term consequences of consumption. Results further showed that rationality levels (as measured through budget loss) of deliberative and affective system evaluations were high and comparable, but that the overall rationality level across both types of evaluations was significantly lower. It thus seems that a discrepancy between deliberative system and affective system evaluations is responsible for a loss of utility in consumers' economic decisions, rather than a specific type of evaluation (deliberative versus affective, like is more typically assumed) itself.

In the parts that follow, we will focus on behavioral engineering techniques that can help consumers strike a balance between short-term and long-term consequences of consumption, and hence engage in more competent decision-making. We will go into the idea of nudging first, and then explore possibilities to trigger enduring behavioral change in consumers.

Nudges

As already argued, a lot of decisions relating to eating behavior are made without much conscious deliberation. This implies that consumers tend to rely on salient cues in the decision environment that trigger 'easy' responses (Wansink 2004). For instance, whereas consumers may not have an explicit intention to choose the chocolate pie over the fruit salad, they may end up doing so when the chocolate pie is within reach and the fruit salad is not. Given the observation that food decisions are often made relatively mindlessly and that environmental cues therefore can play a large part in steering these decisions, we explore the possibility that nudging is a potentially powerful technique to trigger behavioral change.

Nudging builds on insights derived from psychology and behavioral economics suggesting that a lot of behavioral decisions result from quick-and-easy (heuristic) rather than elaborate processing, which helps explain the limited success of standard health-promotion strategies relying on rationality of the decision maker. Nudges should be understood as simple changes in the decision environment that make the (in this context) healthy food choice the easy, automatic, or default choice (Thaler and Sunstein 2008). Nudges sidestep undue intervention and preserve consumers' autonomy (Hausman and Welch 2010). For instance, putting the fruit salad rather than the chocolate pie within reach nudges consumers towards selecting the fruit salad, though they still have the option to go for the chocolate pie in case they really want to.

There is empirical evidence for the impact of distance to food on food consumption. In one recent paper, it was shown that making chocolates less accessible by increasing the distance to the chocolates decreased the probability of consumption and also the number of chocolates consumed (Maas et al. 2012). Specifically, participants were randomly assigned to one of three experimental conditions in which a bowl of chocolates was placed in close proximity (distance of 20 cm), within reach (distance of 70 cm), or relatively far away such that participants needed to get up and walk over to the chocolates in order to take some (distance of 140 cm). In all three conditions, the chocolates were clearly visible to participants. After participants had been exposed to the chocolates for five minutes while engaging in unrelated tasks, their chocolate intake was measured. Probability of consumption and the number of chocolates consumed decreased significantly when the distance to the chocolates increased from 20 to 70 cm. An additional increase in distance from 70 to 140 cm did not decrease the probability of consumption or the number of chocolates consumed further, however. These findings suggest

that the exact position of tempting foods in decision environments has an impact on food choices, and thus may be used as a nudge to trigger change in food choices.

In one recent study conducted in our lab (Joye and Bruyneel in preparation), we sought to exploit the finding that men more easily process the global level of visual stimuli, whereas women more easily process the local level of visual stimuli they encounter in their decision environment, and apply it as a nudge to influence food choices. For instance, in Navon tasks in which participants are exposed to pictures of larger letters composed of smaller letters, and are asked to either identify the large or the small letters, men typically identify the larger letter quicker, whereas women typically identify the smaller letter quicker. Such findings have been explained by gender differences in brain lateralization (e.g., Roalf et al. 2006). Given that easy processing of visual stimuli presentations boosts desirability and liking (e.g., Lee and Labroo 2004), we expected men to display a greater liking for food items arranged in a global manner, and women to display a greater liking for food items arranged in a local manner. We also used a Navon task to manipulate global versus local presentation, but we used large letters made up of small pictures of chocolate letters instead of regular print letters, as is usually done in Navon studies. Participants were randomly assigned to one of two conditions. In the global condition, they were presented with global T's and global H's which consisted of small L's or F's. In the local condition, we presented participants with global L's and global F's which consisted of small T's or H's. All participants were instructed to identify as quickly as possible whether the letter presented was a T or H. As such, they had to repeatedly focus on either the global (global condition) or the local letter (local condition), allowing them to adopt a global or local visual perspective, respectively. In the second phase of the study, participants rated the pictures of the chocolate letters that were used in the Navon task, and indicated how attractive they found the

chocolate, and how much they wanted to eat it at that moment. We observed that females participants were quicker to identify the local letters than the global letters, whereas male participants were directionally quicker to identify the global letters than the local letters, which is in agreement with earlier research providing evidence for gender differences in preferential visual focus. Interestingly, ease-of-processing accordingly influenced liking for the chocolate presented. That is, female participants indicated to like the chocolate more in the local versus global condition, whereas male participants' liking for the chocolate letters was directionally higher in the global than the local condition. These preliminary findings suggest that the way in which food is presented (i.e., whether it requires global versus local processing) can be used as a nudge to influence food choice and consumption. Specifically, decision makers will be more eager to select food that is presented in such a way that it is easy to process, or conversely, will be less eager to select food that is presented in such a way that it is difficult to process.

In the next part, we will explore mechanisms underlying enduring behavioral change in consumers.

Behavioral consolidation

In the previous section, we discussed how the environment can be designed in such a way that the lure of chocolate can be weakened, which leads to less impulsive behavior. Although nudges can be very effective they have an important weakness: They entirely rely on the situation. If for some reason the decision maker is no longer in the well-crafted decision situation or the situation cannot be controlled sufficiently effectively, the nudges lose their power. Schools could, for instance, design their food distribution system based on the principle of nudges. They could offer

healthy alternatives, put the vending machine with chocolate in a remote section of the school, or set up a system that requires the young consumers to use a token to buy chocolate or candy, which sets an additional hurdle to consume vice products. But then again, as soon as the adolescents leave the school, chocolate and other unhealthy snacks are up for grabs. In this section, we explore a more sustainable technique: Behavioral consolidation.

The basic and crucial assumption underlying behavioral consolidation builds on the insight that preferences, although relatively stable across time, are malleable to some extent. There is plenty of evidence that taste preferences, most relevant to our discussion of chocolate consumption, change in the short as well as the long run (Kemps et al. 2014). The short run fluctuations, although not trivial as determinants of real life chocolate consumption, are well known (e.g. nudging consumers to avoid chocolate by putting if further away, Maas et al. 2012). We focus on more stable preference changes here. Research in our lab (Geyskens et al. 2008) brought female young adult respondents in a situation in which chocolate was present (in the form of Quality Street © candy), and the respondents were invited to engage in a product knowledge test. They received a sheet of paper showing different types of Quality Street candies (Quality Street candies come in different flavors) and flavor descriptions, and were asked to connect the wrappings of the candies to the flavors. The candies were presented physically on the side to help them see the wrappings better. As eating the candy during this task would make the test useless, this task subtly nudged them towards not eating the candy. Indeed, throughout the studies, no-one took a candy during the product knowledge test. Subsequently, respondents engaged in a different study, which was a taste test with the purpose of rating a new type of chocolate candy (a new type of M&Ms©) on several product characteristics. This task required them to sample the chocolate but did not specify how much they had to eat to provide a valid

assessment. The researchers measured how much respondents spontaneously ate. This treatment (pre-exposure without consumption) was compared to (1) a group that did not see the real chocolate candies (but only the pictures of the candy during the product knowledge test) and (2) a group that was not exposed to chocolate candy at all but got a similar knowledge task during the first phase of the study. The researchers found that those in the pre-exposure/no consumption treatment condition consumed less during the taste test than the other two groups. Further studies with the same treatment but with other measurements suggested that respondents in the exposure/no consumption treatment condition relied on strategies to deal with the tempting situation: They seemingly liked the chocolate less, which presumably was their way of resisting the presented candy and being able to focus on the task at hand. This happened only in the pre-exposure/no consumption condition and not in the two control conditions. As the respondents had been randomly assigned to the conditions, this difference is most likely due to the differential treatment. These findings suggest that consumers may change their preference for chocolate as a strategy to deal with the challenge of not eating the chocolate. These results hold a promise for designing more durable treatments.

In the wake of this initial set of studies, several studies have been undertaken to investigate the scope and the nature of this effect. Understanding what underlies it sets the stage for applying the effect in real life contexts. One line of efforts has focused on children. Tasks were designed that would be more involving for children. In one study, children of seven to nine years old had to solve word puzzles. One group got candy letters to do so, whereas the other group received carton board letters to make the puzzles. The children who had made word puzzles with candy letters in the first phase subsequently sampled fewer chocolate candies (Smarties©) in the subsequent taste test than children who had made the word puzzles with card board letters

(Grubliauskiene and Dewitte 2014). Subsequent studies with flower drawings that had to be constructed either with Lego-bricks© or similarly shaped and colored gummy bear candies confirmed these findings: The children who had been pre-exposed to the candy bears in a context that discouraged eating candies in the first phase, subsequently ate less chocolate candies (Grubliauskiene and Dewitte in preparation a). These studies suggest that the behavioral consolidation technique may also work for children, which suggests a broad scope and a relatively unsophisticated underlying process, as children of this age are still developing their cognitive build-up and have been demonstrated to be poor self-regulators (Mischel and Baker 1975).

Many studies about eating behavior and overconsumption have looked at female populations only. This choice is typically pragmatically motivated because women tend to be more homogeneous in their reactions to food stimuli and treatments, which makes them a more convenient population to study. In the domain of clinical psychology this restriction also makes sense as the incidence of many eating disorders (e.g. bulemia nervosa) is substantially higher among women than among men. In addition, researchers in the health domain share the assumption that (young) women are more concerned about the role food plays in their attractiveness and health. However, the economic costs of overeating are not smaller for men than for women. As the assumed process (changing preferences) underlying the temptation pre-exposure effect we just discussed does not rely on gender-specific factors, this research program has quit the common practice to investigate female populations only. The results were remarkable. Studies relying on men as well as on women as respondents have never shown any reliable difference between both genders in the strength of the effect. For instance, a replication of the initial Geyskens et al. (2008) study described above showed that men as well as women

reduced their spontaneous sampling of chocolate cookies in the context of a taste test when they had been pre-exposed to quality street candies in the context of a product knowledge test (Grubliauskiene and Dewitte in preparation b). With children, the findings have been mixed: using various paradigms, the studies produced effects among boys only (Grubliauskiene and Dewitte 2014), among girls only (de Boer et al. in press), or for both genders (Grubliauskiene and Dewitte in preparation a). The fact that the findings always replicate but not always across both genders suggests that ill-understood situational details that act differently for boys and girls may suppress the effect. Noteworthy is also that the effect was flawlessly replicated in a sample of (predominantly black) south-African students (both men and women) from poor neighborhoods (Grubliauskiene et al. in preparation), attesting the robustness of the effect.

Although managers and policy makers are primarily interested in the question *if* and *for whom* an effect works rather than *how or why* it works, we argue that the question as to how something works can be of high relevance for practitioners. Compare the two following scenarios: the pre-exposure effect described above may rely on the distractive nature of the task that respondents engage in during the pre-exposure phase (such as making the word puzzles). The distraction could reduce the lure of the chocolate during the pre-exposure phase. This reduction could then subsequently be consolidated and be revealed later on, even if the distraction is removed. Alternatively, the effect could also require that respondents experience a struggle between wanting to act on impulse and doing the task right, which are mutually exclusive. In this scenario the task does not distract the consumer from the temptation but instead induces a behavioral conflict. This subtle and seemingly irrelevant psychological difference has profound implications for the implementation of the effect. The former mechanism (distraction) would urge us to make the distracting task as distracting as possible during the phase in which consumers are exposed to

chocolates, whereas the latter mechanism (conflict) would, on the contrary, imply that a task that is very distracting would merely serve as a nudge to not consume and hence reduce the respondent's need to deal with the situation (thus hindering behavioral consolidation). A study in our lab (de Boer et al. 2014 in press), conducted in a primary school, set out to distinguish these mechanisms and put respondents (8-year old children) before the choice to eat their candy immediately, or wait and have it tripled for later consumption. There was no distraction in this setting as respondents could freely choose to consume or to postpone (and triple their profit) while the candy was right in front of them during three tempting minutes. Interestingly, those who had been put in front of the candy in the first phase (without consuming it) consumed less chocolate candy in the subsequent taste test than those who had faced the same conflict with an equally attractive but non-edible toy: marbles. This finding suggests that it is not the distraction that produces the effect but on the contrary the conflict that respondents face. Consistent with the interpretation that the effect relies on a conflict, a follow-up study showed that the effect became even stronger when respondents were asked to imagine how the chocolate would taste and feel like in their mouths than when they were asked to imagine that the candies were toys. Such instructions had been shown before to make the lure more difficult to resist, however (Mischel and Baker 1975). Those who had been asked to focus on the taste of the chocolate during the pre-exposure phase, with the same prospect that waiting would triple their profit, were found to salivate less when given the offer to consume chocolate later on. Salivating is considered as an index of consumption motivation (Wooley and Wooley 1973).

We acknowledge that this combination of treatments is hard to translate outside the lab into a conveniently applicable nudge. However, thinking in terms of underlying processes allows us to distill the essence of the pre-exposure effect: why does asking respondents to think about

chocolate as toys, which *does* reduce immediate consumption, does not yield behavioral consolidation? We suggest that focusing on the non-consumption features of the candy removes the need to actively deal with the lure. Interestingly, some popular practices that are used to control other people's consumption choices may share this essence. Specifically, prohibiting people to consume chocolate, a practice that parents and teachers rely on frequently, may effectively remove the need to resist chocolate in the pre-exposure phase, and thus limit chances of increasing children's competence when it comes to resisting the lure of chocolate. Indeed, a study in our lab replicated the original Geyskens et al. (2008) study but added a group of respondents who were told explicitly not to eat the candies in the pre-exposure phase (Grubliauskiene and Dewitte in preparation b). Against the background that respondents do not eat anyway during the pre-exposure phase as the task invites them not to, this instruction added basically nothing to the situation. Subsequent consumption in the taste test again diminished after pre-exposure, but when we explicitly told participants not to eat during the product knowledge test, the pre-exposure effect disappeared (i.e., they did consume as much chocolate in the second phase of the study as respondents who had received no treatment at all). Apparently, telling respondents not to eat removed the need to solve the behavioral conflict. This set of studies adds an important insight that has broad implications for the behavioral engineering approach: The respondent has to experience the lure of temptation for the beneficial effects to consolidate.

One of the main aims of this research program was to show that the effect of pre-exposure to chocolate temptations would lead to relatively stable behavioral changes as a result of relatively stable preference shifts. However, this claim relies on the very notion that preferences are malleable. We needed to make sure that the observed changes in food choices and consumption would last. In a set of lab studies already described (Grubliauskiene and Dewitte in preparation

b) we inserted a delay of fifteen minutes between the pre-exposure phase and the behavioral measurement. Fifteen minutes is limited from a practical point of view but it is an important step in establishing longevity of the behavioral change, as most transient effects of situational cues (such as nudges or framing effects; Kahneman and Tversky 1979) typically fade in terms of seconds or minutes. The studies showed that the effects remained intact after a 15 minutes' delay. In a follow up study with children (de Boer et al. in press) we increased the delay to 24 hours. Children who had been exposed to candy repeatedly without consuming it (as they were betting on a higher profit) ate less chocolate 24 hours later than children who had followed the same procedure but without the lure of candy. These studies are consistent with the idea that the pre-exposure treatment has lasting effects on consumer preferences, which subsequently makes them more competent in dealing with the lure of chocolate.

Conclusion

The observation that chocolate not only provides immediate utility but also contributes to the rise of obesity and, in its wake, a host of preventable diseases, was the initial motivation for our investigations. We illustrated consumer vulnerability to situational cues and asked ourselves (1) how the economic environment could be (re)designed to help curb chocolate overconsumption and (2) how consumers could be supported to more competently resist the lure of chocolate. We reviewed a series of studies showing that simple environmental modifications (nudges) can reduce chocolate overconsumption. We then proceeded by exploring how a temporary change could be consolidated, thereby enhancing consumers' competence to moderate chocolate consumption even in the absence of supportive situational cues.

We propose that these two steps can be forged into an approach that we would like to introduce as behavioral engineering. Behavioral engineering is more than the sum of nudges and consolidation techniques. Putting the two steps together leads to the insight that nudges may vary in their suitability to lead to consolidation, and that consolidation techniques may vary with respect to their fit with nudging. We will first sketch some guidelines for the design of nudges from the point of view of consolidation, and then proceed with discussing how consolidation could be optimized in a nudging context.

Nudges are typically assessed in terms of their success of achieving the intended behavioral change *in the presence of the nudge*. We propose that nudges could also be assessed for their potential for subsequent consolidation. Our review of the consolidation research program suggests that the experience of behavioral conflict during the temptation phase is a crucial ingredient for consolidation. This suggests that nudges that are very strong and hence potentially very successful in the short run, may not be the best nudges in the long term. Strong nudges may reduce freedom of choice, and hence reduce the need to actively resist the temptation. For instance, putting the candy in a vending machine in a remote section of the school may be very effective in reducing consumption (although the consumers can in principle still buy candy) but may not trigger the behavioral conflict, and hence the changes in consumer preferences. Moderate nudges, on the other hand, may be less effective in stimulating the desired behavior, yet if they do, these behaviors may also be more long-lasting. For instance, rather than putting the vending machine in a remote section, the school may decide to add fruit with a low price to the vending machine. This would induce behavioral conflict for some consumers and some may choose fruit. We propose that the behavioral conflict may then lead to the consolidation of the

choice for the fruit. An important challenge for future research is to determine what 'moderately strong' means exactly.

The consolidation techniques may also need fine-tuning depending on the type of nudge that is conceivable in a certain situation. In our review we focused on changes in preferences, but the consolidation of a behavioral change may also be achieved via praise or labeling. In a study with young children in a school setting, we offered children from seven to eleven years the choice between a chocolate candy and a grape (Grubliauskiene et al. 2012). We bundled a little toy gift to the grape to boost the children's choice for the grape (this is a nudge). Then the teacher praised them when they chose the grape option. Three days later, the children came back to choose between a candy and a grape once more. This time, there was no extra toy involved in any of the options. Those who had been nudged to choose the grape three days earlier and had been subsequently praised, became twice as likely to choose the grape than those who had not been nudged or praised. In a different set of studies, we asked participants to consider buying a T.V.- set. The ecological option was also the best in terms of quality and price. Most respondents chose this set, and the experimenter noted that they must be environmentally conscious consumers. In a later phase in the study, these participants displayed more green behavior (e.g. they used paper more efficiently) (Cornelissen et al. 2007). We expect that this labeling technique may also work in the context of chocolate.

Although promising and remarkably robust across situations and populations, we acknowledge that much remains to be explored about the generalizability of both effects and their optimal match. There may be important conditions for the behavioral engineering approach to work well, which we did not explore yet. The fact that telling respondents explicitly that they shouldn't eat seemingly backfires, illustrates the importance of such endeavors.

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